

## CLAIMS

1. A three-dimensional image photographing apparatus for acquiring image information required for displaying a three-dimensional image of an object in a space, comprising:

5 a single photographing means for photographing the object to generate two-dimensional image information of the object; and photographing direction control means for sequentially changing a photographing direction of the photographing means.

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2. A three-dimensional image photographing apparatus according to Claim 1, wherein the photographing direction control means has deflecting means which is provided between the object and the photographing means and which deflects light by selecting

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3. A three-dimensional image photographing apparatus according to Claim 1, wherein the photographing direction control means has driving means for moving the photographing means.

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4. A three-dimensional image photographing apparatus according to Claim 1, wherein the photographing direction control means has driving means for moving a part of an optical system provided between the object and the photographing means.

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5. A three-dimensional image photographing apparatus

according to Claim 1, wherein the photographing direction control means sets a photographing direction that is the same for all pixels of the two-dimensional image information and sequentially changes the photographing direction.

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6. A three-dimensional image photographing apparatus according to Claim 1, wherein the photographing direction control means sets a photographing direction that is different for each pixel of the two-dimensional image information and sequentially changes the photographing direction for each pixel.

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7. A method for photographing a three-dimensional image for acquiring image information required for displaying a three-dimensional image of an object in a space, the method including:

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a photographing step for photographing the object with a single photographing means to generate two-dimensional image information of the object; and

a photographing direction controlling step for sequentially changing a photographing direction at the photographing step.

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8. A method for photographing a three-dimensional image according to Claim 7, wherein the photographing direction controlling step deflects light by selecting a direction for incident light between the object and the photographing means,

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thereby changing the photographing direction.

9. A method for photographing a three-dimensional image according to Claim 7, wherein the photographing direction  
5 controlling step changes the photographing direction by moving the photographing means.

10. A method for photographing a three-dimensional image according to Claim 7, wherein the photographing direction  
10 controlling step changes the photographing direction by moving a part of an optical system provided between the object and the photographing means.

11. A method for photographing a three-dimensional image  
15 according to Claim 7, wherein the photographing direction controlling step sets a photographing direction that is the same for all pixels of the two-dimensional image information and sequentially changes the photographing direction.

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12. A method for photographing a three-dimensional image according to Claim 7, wherein the photographing direction controlling step sets a photographing direction that is different for each pixel of the two-dimensional image information and sequentially changes the photographing direction for each pixel.

13. A three-dimensional image photographing apparatus for

acquiring image information required for displaying a three-dimensional image of an object in a space, comprising:

photographing means for photographing the object to generate two-dimensional image information of the object;

5        photographing direction setting means for setting a photographing direction for the photographing means, capable of setting a different photographing direction for each pixel of the two-dimensional image information; and

10        photographing control means for controlling the photographing direction setting means to acquire two-dimensional image information with a low resolution that is lower than the resolution of the photographing means in every photographing direction that can be set, and for repeatedly performing a process of generating the two-dimensional image with the low resolution  
15 while changing pixels to which a specific photographing direction is assigned, to acquire two-dimensional image information with the same resolution as the resolution of the photographing means in every photographing direction that can be set.

20        14. A three-dimensional image photographing apparatus according to Claim 13, wherein the photographing control means divides a two-dimensional image region into a plurality of sub-regions each having A pixels (A is an integer equal to or greater than 2) and sets each of all the photographing directions  
25 that can be set for one pixel in each of the sub-regions to acquire the two-dimensional image information with the low resolution,

the low resolution being  $1/A$  of the resolution of the photographing means, and repeats a process of generating the two-dimensional image information with the low resolution  $A$  times while changing pixels to which a specific photographing direction is assigned  
5 in the sub-regions, to acquire the two-dimensional image information with the same resolution as the resolution of the photographing means.

15. A three-dimensional image photographing apparatus  
10 according to Claim 14, wherein the photographing control means divides all of the photographing directions that can be set into groups each consisting of  $A$  photographing directions and repeatedly performs a process of generating the two-dimensional image information with the low resolution in the  $A$  photographing  
15 directions to acquire two-dimensional image information with the low resolution in all of the photographing directions that can be set.

16. A three-dimensional image photographing apparatus  
20 according to Claim 13, wherein the photographing direction setting means has defecting means which is provided between the object and the photographing means and which deflects light by selecting a direction for incident light.

25 17. A method for photographing a three-dimensional image for acquiring image information required for displaying a

three-dimensional image of an object in a space using:  
 photographing means for photographing the object to generate  
 two-dimensional image information of the object; and  
 photographing direction setting means for setting a photographing  
 5 direction for the photographing means, capable of setting a  
 different photographing direction for each pixel of the two-  
 dimensional image information, the method including:

a first step for controlling the photographing direction  
 setting means to acquire two-dimensional image information with  
 10 a low resolution that is lower than the resolution of the  
 photographing means in every photographing direction that can be  
 set; and

a second step for repeatedly performing the first step while  
 changing pixels to which a specific photographing direction is  
 15 assigned, to acquire two-dimensional image information with the  
 same resolution as the resolution of the photographing means in  
 every photographing direction that can be set.

18. A method for photographing a three-dimensional image  
 20 according to Claim 17, wherein the first step divides a two-  
 dimensional image region into a plurality of sub-regions each  
 having A pixels (A is an integer equal to or greater than 2) and  
 sets each of all the photographing directions that can be set for  
 one pixel in each of the sub-regions to acquire the two-dimensional  
 25 image information with the low resolution, the low resolution  
 being  $1/A$  of the resolution of the photographing means, and the

second step repeats the first step A times while changing pixels to which a specific photographing directions is assigned in the sub-regions to acquire the two-dimensional image information with the same resolution as the resolution of the photographing means.

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19. A method for photographing a three-dimensional image according to Claim 18, wherein the first step divides all of the photographing directions that can be set into groups each consisting of A photographing directions and repeatedly performs  
 10 a process of acquiring the two-dimensional image information with the low resolution in the A photographing directions to acquire two-dimensional image information with the low resolution in all of the photographing directions that can be set.

15 20. A three-dimensional image display apparatus for displaying a three-dimensional image of an object in a space by projecting a plurality of pieces of two-dimensional image information of the object obtained by viewing the object in different viewing directions, in projecting directions that are  
 20 associated with the respective viewing directions, comprising:

projecting means for projecting the two-dimensional image information of the object;

projecting direction setting means for setting a projecting direction for the projecting means, capable of setting  
 25 a different projecting direction for each pixel of the two-dimensional image information; and

display control means for displaying a three-dimensional image with a low resolution by controlling the projecting direction setting means to project two-dimensional image information with a low resolution that is lower than the resolution of the projecting means in every projecting direction that can be set, and for repeatedly performing a process of projecting the two-dimensional image information with the low resolution while changing pixels to which a specific projecting direction is assigned, to display a three-dimensional image with the same resolution as the resolution of the projecting means.

21. A three-dimensional image display apparatus according to Claim 20, wherein the display control means divides a two-dimensional image region into a plurality of sub-regions each having A pixels (A is an integer equal to or greater than 2) and sets each of all the projecting directions that can be set for one pixel in each of the sub-regions to project the two-dimensional image information with the low resolution, the low resolution being  $1/A$  of the resolution of the projecting means, thereby displaying a three-dimensional image with a low resolution, and repeatedly performs a process of projecting the two-dimensional image information with the low resolution A times while changing pixels to which a specific projecting direction is assigned in the sub-regions, to display the three-dimensional image with the same resolution as the resolution of the projecting means.



22. A three-dimensional image display apparatus according to Claim 21, wherein the display control means divides all of the projecting directions that can be set into groups each consisting of A projecting directions, and repeatedly performs a process of  
5 projecting the two-dimensional image information with the low resolution in the A projecting directions to project the two-dimensional image information with the low resolution in all of the projecting directions that can be set.

10 23. A three-dimensional image display apparatus according to Claim 20, wherein the projecting direction setting means has deflecting means for deflecting light by selecting a direction for exiting light.

15 24. A method for displaying a three-dimensional image for displaying a three-dimensional image of an object in a space by projecting a plurality of pieces of two-dimensional image information of the object obtained by viewing the object in different viewing directions, in projecting directions that are  
20 associated with the respective viewing directions, using projecting means for projecting the two-dimensional image information of the object and projecting direction setting means for setting a projecting direction for the projecting means, capable of setting a different photographing direction for each  
25 pixel of the two-dimensional image information, the method including:

a first step for controlling the projecting direction setting means to acquire two-dimensional image information with a low resolution that is lower than the resolution of the projecting means in every projecting direction that can be set, thereby displaying a three-dimensional image with a low resolution; and

a second step for repeatedly performing the first step while changing pixels to which a specific projecting direction is assigned, to display a three-dimensional image with the same resolution as the resolution of the projecting means.

25. A method for displaying a three-dimensional image according to Claim 24, wherein the first step divides a two-dimensional image region into a plurality of sub-regions each having A pixels (A is an integer equal to or greater than 2) and sets each of all the projecting directions that can be set for one pixel in each of the sub-regions to project the two-dimensional image information with the low resolution, the low resolution being  $1/A$  of the resolution of the projecting means, thereby displaying the three-dimensional image with the low resolution, and the second step repeatedly performs the first step A times while changing pixels to which a specific projecting direction is assigned in the sub-regions to display a three-dimensional image with the same resolution as the resolution of the projecting means.

26. A method for displaying a three-dimensional image according to Claim 25, wherein the first step divides all of the projecting directions that can be set into groups each consisting of A photographing directions, and repeatedly performs a process  
5 of projecting the two-dimensional image information with the low resolution in the A projecting directions to project the two-dimensional image information with the low resolution in all of the projecting directions that can be set.

10 27. A three-dimensional image display position converting apparatus used in a system for displaying a three-dimensional image of an object in a space by projecting a plurality of pieces of two-dimensional image information of the object obtained by viewing the object in different viewing directions, in projecting  
15 directions that are associated with the respective viewing directions, the apparatus converting the position of the three-dimensional image of the object displayed in the space and comprising:

quantity-of-movement calculating means for identifying a  
20 quantity of a movement of a position of the two-dimensional image information in a direction in the plane thereof that is required for moving a position of the three-dimensional image by a specific quantity of movement, based on information on the quantity of movement of the position of the three-dimensional image and the  
25 viewing directions or the projecting directions; and

position changing means for changing the position of the

two-dimensional image information by the quantity of movement identified by the quantity-of-movement calculating means.

28. A three-dimensional image display position converting  
 5 apparatus according to Claim 27, wherein the quantity-of-movement  
 calculating means identifies the quantity of movement of the  
 position of the two-dimensional image information as a value  
 proportionate to "b" which is expressed by  $b = a \times \tan \theta_i$  where  
 "a" represents the quantity of movement of the three-dimensional  
 10 image and  $\theta_i$  represents the viewing directions or the projecting  
 directions.

29. A three-dimensional image display position converting  
 apparatus according to Claim 27, wherein the position changing  
 15 means has: storage means for storing the two-dimensional image  
 information; and address control means for changing the position  
 of the two-dimensional image information by controlling write  
 addresses for writing the information in the storage means and  
 read addresses for reading the information from the storage means.

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30. A three-dimensional image display position converting  
 apparatus according to Claim 27, the apparatus being provided in  
 a three-dimensional image photographing apparatus for  
 photographing an object in a plurality of viewing directions to  
 25 generate a plurality of pieces of two-dimensional image  
 information of the object in different viewing directions.

31. A three-dimensional image display position converting apparatus according to Claim 27, the apparatus being provided in a three-dimensional image display apparatus for displaying a three-dimensional image of an object in a space by projecting a plurality of pieces of two-dimensional image information of the object obtained by viewing the object in different viewing directions, in projecting directions that are associated with the respective viewing directions.

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32. A method for converting a display position of a three-dimensional image which is used in a system for displaying a three-dimensional image of an object in a space by projecting a plurality of pieces of two-dimensional image information of the object obtained by viewing the object in different viewing directions, in projecting directions that are associated with the respective viewing directions, and which is used for converting the position of the three-dimensional image of the object in the space, the method including:

20 a quantity-of-movement calculating step for identifying a quantity of a movement of a position of the two-dimensional image information in a direction in the plane thereof that is required for moving a position of the three-dimensional image by a specific quantity of movement, based on information on the quantity of movement of the position of the three-dimensional image and the viewing directions or the projecting directions; and

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a position changing step for changing the position of the two-dimensional image information by the quantity of movement identified by the quantity-of-movement calculating step.

5           33. A method for converting the display position of a three-dimensional image according to Claim 32, wherein the quantity-of-movement calculating step identifies the quantity of movement of the position of the two-dimensional image information as a value proportionate to "b" which is expressed by  $b = a \times \tan\theta_i$   
10       where "a" represents the quantity of movement of the three-dimensional image and  $\theta_i$  represents the viewing directions or projecting directions.

15           34. A method for converting the display position of a three-dimensional image according to Claim 32, the position changing step changes the position of the two-dimensional image information by controlling write address for storing information in storage means for storing the two-dimensional image information and read address for reading the information from the  
20       storage means.